

[0055] FIG. 11 is a flowchart for describing sequential operations of connecting adjacent triangular patches having different LOD levels without gaps in accordance with an embodiment of the present invention.

[0056] The operation stage 106 proceeds when it is determined that the selected triangular patch has a different LOD level from the adjacent triangular patch in operation 104 described in FIG. 10. In operation 106, it is determined whether the selected triangular patch has a lower level (higher resolution) than the adjacent triangular patch.

[0057] If the selected triangular patch has a lower level, in operation 107, the selected triangular patch is represented with a currently set LOD level.

[0058] If it is determined that the selected triangular patch (corresponding to a patch of a lower hierarchical level) is at the same or upper LOD level in operation 106, the number of the triangular patches having the lower level among the adjacent triangular patches to the selected triangular patch (i.e., the number of patches of the lower hierarchical level) is determined in operation 108.

[0059] If it is determined that the number of the patches of the lower hierarchical level is 3 in operation 109, as described in FIG. 7(a), in operation 110, unit triangular patches included in the triangular patches of the lower hierarchical level are connected with each other such that the selected triangular patch of the upper hierarchical level has the same unit triangular patch structure as the triangular patch structure of the lower hierarchical level.

[0060] If it is determined that the number of the patches of the lower hierarchical level adjacent to the selected triangular patch of the upper hierarchical level is 2 in operation 111, in operation 112, as described in FIGS. 7(b) to 7(d), vertices of the unit triangular patches within the triangular patches of the lower hierarchical level, which are disposed in the boundaries between the triangular patches of the lower hierarchical level and the triangular patches of the selected upper hierarchical level, are connected consecutively with each other in a zigzag pattern.

[0061] If the number of the patches of the lower hierarchical level adjacent to the selected triangular patch of the upper hierarchical level is 1, as described in FIGS. 7(e) to 7(g), all vertices of the unit triangular patches of the triangular patches within the lower hierarchical level disposed in the boundaries between the triangular patches of the lower hierarchical level and the triangular patches of the upper hierarchical level are connected with vertices of the triangular patches of the upper hierarchical level facing to the boundary line, and as a result, the hierarchical mesh according to the present embodiment can be obtained.

[0062] The above described method for representing three-dimensional images with a multi-level LOD using the multi-level LOD hierarchical mesh can be implemented as computer readable codes in a computer readable recording medium. The computer readable recording medium includes various types of recording medium into which data can be read by a computer system are stored. Examples of the computer readable recording medium are ROM, RAM, CD-ROM, magnetic tapes, floppy disks, and optical data storing devices. Also, the computer readable recording medium can include one realized in the form of a carrier wave such as transmission through Internet. Also, codes

which can be read by the computer based on a distribution mode are stored into the computer readable recording medium distributed within a computer system connected via a network and can also be executed.

[0063] According to the exemplary embodiments of the present invention, the multi-level LOD hierarchical mesh is configured using the triangular patches. Particularly, a mesh of a target image such as terrain is configured using information on height allocated to each vertex of the triangular patches included in the hierarchical mesh, and thus, usage of memory resources of a computer system can be reduced by approximately 3-fold.

[0064] Also, different from the conventional PM based method of dynamically generating vertices of the mesh, the multi-level LOD hierarchical mesh is configured in advance, and pieces of information on indices of vertices of the triangular patches for the hierarchical mesh are arranged separately. As a result, patches with various LOD levels can be produced and represented in real time.

[0065] In addition to the precedent configuration of the multi-level LOD hierarchical mesh and determination of the LOD of each patch using the index information for the vertices of the triangular patches used in the multi-level LOD hierarchical mesh configuration, connecting the triangular patches with different LOD levels without gaps can reduce usage of computation resources used for merging or separating the triangular patches.

[0066] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. An apparatus for representing a three-dimensional image with a multi-level LOD (level of detail), comprising:

a patch configuration unit configuring a multi-level LOD hierarchical mesh for each hierarchical level with a different LOD level by arranging triangular patches of a upper hierarchical level (level $m+1$, lower resolution) to have approximately $k \times k$ of triangular patches of an lower hierarchical level (level m , higher resolution), where k is the number of horizontal and vertical grids of the lower hierarchical level and sampling information on height of a target image on a regular basis to allocate the sampled height information to each vertex of the triangular patches included in the multi-level LOD hierarchical mesh;

an LOD determination unit determining an LOD of each triangular patch according to a view point of a virtual camera; and

a patch connection unit connecting the adjacent triangular patches with each other without gaps when the adjacent triangular patches among the triangular patches of the multi-level LOD hierarchical mesh have different LOD levels.

2. The apparatus of claim 1, wherein the LOD level of the upper hierarchical level is lower than that of the lower hierarchical level.